

OENPELLIAN; Uniface (*Pirri*) points and biface points, *elouera* adz-flake as the dominant flake type, a variety of scrapers (many of microlithic size but none of geometrical type present), *Leilira* quartzite blades, flake-fabricated hammerstones, red and yellow pigments, bone *muduk* points, pestle and mortars; *elouera*, flake and blades with use-polished working edge. Associated with top deposit and bundle burials, modern iron nails and implements, twined and netted bag fragments, wooden weapons, trade beads.

This note serves only as a general description of an important archeological discovery in Arnhem Land. The authors are preparing detailed reports of their anthropological investigations during the eight months of field work in this northern section of Australia. This international expedition, led by the Australian representative C. P. Mountford, was made possible through the joint sponsorship of the Commonwealth of Australia, the National Geographic Society, and the Smithsonian Institution.

LITERATURE CITED

- BASEDOW, H. *Anthropological notes on the western coastal tribes of the Northern Territory of South Australia*. Trans. Roy. Soc. South Australia **31**: 1-62, figs. 1-72, pls. 1-19. 1907.
- CAMPBELL, T. D., and NOONE, H. V. V. *Some aboriginal camp sites in the Woakwine Range region of the south east of South Australia*. Rec. South Australian Mus. **7**: 371-395, figs. 1-157. 1943.
- HALE, H. M., and TINDALE, N. B. *Notes on some human remains in the Lower Murray Valley, South Australia*. Rec. South Australian Mus. **4**: 145-218, figs. 1-249. 1930.
- McCARTHY, F. D. *An analysis of the knapped implements from eight elouera industry stations on the south coast of New South Wales*. Rec. Australian Mus. **21**: 127-153, figs. 1-103. 1943.
- . *The coroid and knapped implements of the Bathurst District*. Rec. Australian Mus. **21**: 199-209, figs. 1-48. 1943.
- . *An analysis of the large stone implements from five workshops on the north coast of New South Wales*. Rec. Australian Mus. **21**: 411-430, figs. 1-22, pls. 36-39. 1947.
- . *The Lapstone Creek excavation: Two culture periods revealed in eastern New South Wales*. Rec. Australian Mus. **22**: 1-34, figs. 1-94, pls. 1-4. 1948.
- , BRAMWELL, E., and NOONE, H. V. V. *The stone implements of Australia*. Mem. Australian Mus. **9**: 1946.
- and DAVIDSON, D. A. *The elouera industry of Singleton, Hunter River, N. S. Wales*. Rec. Australian Mus. **21**: 210-230, figs. 1-117. 1943.
- NOONE, H. V. V. *Some aboriginal stone implements of Western Australia*. Rec. South Australian Mus. **7**: 271-280, figs. 1-31. 1943.
- SPENCER, SIR W. BALDWIN. *Native tribes of the Northern Territory of Australia*. London, 1914.
- TINDALE, N. B. *Natives of Groote Eylandt and of the west coast of the Gulf of Carpentaria*. Rec. South Australian Mus. **3**: 61-102. 1925; 103-134. 1926.
- WARNER, W. LLOYD. *A black civilization*. 1937.
- PALEONTOLOGY.—*North American Jurassic Foraminifera, II: Characteristic western interior Callovian species*.¹ ALFRED R. LOEBLICH, JR., U. S. National Museum, and HELEN TAPPAN, U. S. Geological Survey.

Callovian (basal Upper Jurassic) beds contain rich and well-preserved foraminiferal assemblages in many parts of the western interior of the United States and Canada. In the eastern area of exposures around the Black Hills of South Dakota and Wyoming the medial part of the Lower Callovian consists in large part of sandy siltstone that contains abundant Ostracoda and sparsely developed foraminiferal assemblages dominated by simple lagenids and arenaceous Foraminifera. Toward the west in Wyoming

and Montana the Callovian strata become more calcareous, and Foraminifera dominate the microfossil assemblages. The foraminiferal assemblages are also more diversified to the west and are characterized by a great variety of lagenids and lituolids.

The writers have in preparation a monographic treatment of the western interior Jurassic Foraminifera but are here recording a few of the more characteristic species, so that they may be of use in stratigraphic work now in progress in the area. The field work was undertaken as a project of the U. S. Geological Survey, and the writers are indebted to Dr. Ralph W. Imlay for his valuable assistance in the field and to Dr.

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John B. Reeside, Jr., for his interest and aid in making possible the field study and collection of material.

DESCRIPTION OF LOCALITIES

Locality 1.—Ellis group. At the southwest corner of Red Dome, east of Bridger, in the Pryor Mountains, sec. 19, T.7S., R.24E., Carbon County, Montana. Collected September 13, 1948, by Ralph W. Imlay and Alfred R. Loeblich, Jr. A complete section of the Ellis Group (Piper, Rierdon and Swift formations) is well exposed at this locality.

Locality 2.—Ellis group. One mile southwest of Piper on the northwest corner of the escarpment due east of Bacon Ranch, sec. 17, T.14N., R.20E., Fergus County, Montana. Collected September 14, 1948, by Ralph W. Imlay and Alfred R. Loeblich, Jr. This locality includes the type section of the Piper formation, an excellent exposure of the Rierdon formation, and the basal portion of the Swift formation.

Locality 3.—Sundance formation. On the west side of Stockade Beaver Creek, 5 miles northeast of Newcastle, sec. 18, T.45N., R.60W., Weston County, Wyoming. Collected September 21, 1948, by Ralph W. Imlay and Alfred R. Loeblich, Jr. This locality is the type section of the Stockade Beaver shale member, and in addition, the Hulett sandstone member, the Lak member, and the basal part of the Redwater shale member of the Sundance are well shown.

Locality 4.—Sundance formation. Along the east side of Red Gulch, about 2½ miles south of little Big Horn River in sec. 22, T.58N., R.89W., Sheridan County, Wyoming. Collected by R. W. Imlay and A. R. Loeblich, Jr., September 23, 1948. This locality affords excellent exposures of the Stockade Beaver shale member, Hulett sandstone member, and Redwater shale member of the Sundance.

Locality 5.—In the gorge of the Shoshone River, 1¼ miles west of Cody, Park County, Wyoming. Collected September 19, 1948, by Ralph W. Imlay and Alfred R. Loeblich, Jr. This locality exposes in detail the entire marine Jurassic sequence found in this area.

Locality 6.—Sundance formation. On the east side of Elk Mountain, about 15 miles southeast of Newcastle, Wyoming, in the S½ sec. 19, T.4S., R.1E., South Dakota. Collected September 22, 1948, by Ralph W. Imlay and A. R. Loeblich, Jr. This locality is an excellent one for the lower portion of the Stockade Beaver shale member.

Locality 7.—Sundance formation. In the J. H. Kline Well no. 1, 3½ miles southeast of Carpio, Ward County, North Dakota.

DESCRIPTION OF FORAMINIFERA

Family AMMODISCIDAE

Subfamily AMMODISCINAE

Genus *Ammodiscus* Reuss, 1861

Ammodiscus cheradospirus Loeblich and Tappan, n. sp.

Pl. 1, figs. 1-2b

Test free, medium-sized, discoidal, somewhat irregularly planispirally coiled, periphery rounded with margins irregular; proloculum, in holotype 0.08 mm in diameter, circular, tubular second chamber increasing gradually in size, only occasionally overlapping the preceding coil; spiral suture distinct, depressed; wall very finely arenaceous, with much cement, insoluble in acid; aperture formed by the open end of the tubular chamber.

Maximum diameter of holotype 0.68 mm, diameter of figured paratype 0.44 mm, maximum thickness 0.10 mm. Other specimens vary in diameter from 0.55 mm to 1.53 mm.

Types and occurrence.—Holotype (U.S.N.M. no. 106014) and figured paratype (U.S.N.M. no. 106015) and unfigured paratypes (U.S.N.M. no. 106016) from the Rierdon formation, 33 feet above the base, at locality 1. Specimens are common in this level of the Rierdon formation at this locality.

Remarks.—This species differs from *Ammodiscus gaultinus* Berthelin from the Lower Cretaceous of France in being more regularly planispiral and in being somewhat larger in size.

Family LITUOLIDAE

Subfamily HAPLOPHRAGMIINAE

Genus *Frankeina* Cushman and Alexander, 1929

Frankeina commutata Loeblich and Tappan, n. sp.

Pl. 1, figs. 3a-4

Frankeina sp.? Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. iv, 27: 158, pl. 1, fig. 2. 1933.

Test free, medium-sized, elongate, compressed and planispiral in the early part, later uniserial and triangular in section, periphery rounded; planispiral chambers strongly compressed, comprising a relatively large portion of the test, about one and two-thirds volutions in the coil;

later portion uniserial, chambers increasing slowly in diameter, in the holotype the final chamber being less in diameter than the early coil, sides moderately excavated; sutures generally indistinct, in the coiled part straight or with a very slight backward curve, very slightly depressed in the uniserial portion, but generally indistinct except at peripheral angles; wall medium to coarsely arenaceous, surface roughly finished; aperture rounded on a slight neck.

Length of holotype 1.77 mm, greatest diameter of coiled part 0.75 mm, greatest width of uniserial portion 0.68 mm, width from center of side through opposite angle 0.39 mm; greatest diameter of coil in figured paratype 0.55 mm. Other specimens vary from 0.65 mm to 1.92 mm in length and in diameter of early coiled part from 0.39 mm to 0.75 mm.

Types and occurrence.—Holotype (U.S.N.M. no. 106017) and unfigured paratypes (U.S.N.M. no. 106018) from 99 feet above the base of the Rierdon formation, unfigured paratypes (U.S.N.M. no. 106019) from 104 feet above base of Rierdon formation, unfigured paratypes (U.S.N.M. no. 106020) from 134 feet above the base of the Rierdon formation, all from locality 5; figured paratype (U.S.N.M. no. 106021) and unfigured paratypes (U.S.N.M. no. 106022) from 81 feet above the base of the Rierdon formation, unfigured paratypes (U.S.N.M. no. 106023) from 33 feet above the base of the Rierdon formation, all from locality 1; unfigured paratypes (U.S.N.M. no. 106024) from the Stockade Beaver shale member of the Sundance, 47 to 52 feet above the base, at locality 4. Wickenden recorded the species from about the middle of the Jurassic sequence in the subsurface of Saskatchewan. *Frankeina* in the western interior Jurassic is common in the calcareous shales of the Rierdon and equivalent strata, and with the exception of an occurrence of a related species (U.S.N.M. no. 106025) in the lower part of the Swift formation (*Quenstedtoceras collieri* zone) in the Little Rocky Mountains, it appears to be restricted to this interval.

Remarks.—This species is closer to *Frankeina incerta* Alexander and Smith, from the Lower Cretaceous of Texas, than to any other described species, in size and in having a comparatively large coil. The Jurassic form differs in having a more pronounced coil, of diameter equal to the breadth of the later triangular portion, and in lacking the *Flabellamina* stage characteristic of *F. incerta*, before the triangular character appears.

The chambers do not enlarge so rapidly, the sides are more excavated and the sutures are more distinct in *F. commutata*, n. sp.

Family LAGENIDAE

Subfamily NODOSARIINAE

Genus *Lenticulina* Lamarek, 1804

Lenticulina dilecta Loeblich and Tappan, n. sp.

Pl. 1, figs. 5a-8

Lenticulina helios (Terquem), Sandidge, Amer. Midland Nat. **14**: 178, pl. 1, figs. 1-2. 1933.

Lenticulina sarthacensis (Schwager), Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. IV, **27**: p. 160, pl. 1, figs. 9 and 11 (not fig. 10). 1933.

Test free, lenticular, of medium size, close-coiled, but not completely involute, earlier coils visible in the umbilical region, generally planispiral, but occasional specimens distinctly trochoid, periphery subacute, with a keel; chambers numerous, increasing in size as added, 9 to 11 in the final whorl, depressed centrally; sutures slightly curved, distinct, raised and limbate, occasionally with minute lateral projections on the surface; wall calcareous, hyaline, surface ornamented by the peripheral keel, the elevated sutures which are thickest and highest toward the umbonal area, and the depressed umbilicus, with an encircling ridge formed by the coalescing ends of the sutures; aperture at the peripheral angle, rounded, occasionally faintly crenulated at the margins, showing a tendency toward the radiate character of younger species of the genus.

Greatest diameter of holotype 0.70 mm, least diameter 0.49 mm, greatest thickness 0.26 mm. Other specimens are from 0.34 mm to 0.81 mm in greatest diameter.

Types and occurrence.—Holotype (U.S.N.M. no. 106026), figured paratypes (U.S.N.M. no. 106027 a-c) and unfigured paratypes (U.S.N.M. no. 106028) from 104 feet above the base of the Rierdon formation, unfigured paratypes (U.S.N.M. no. 106029) from 99 feet above the base of the Rierdon formation, all from locality 5; unfigured paratypes (U.S.N.M. no. 106030) from the Rierdon formation, 33 feet above the base, at locality 1; unfigured paratypes (U.S.N.M. nos. 106031 to 106034) from cuttings in the Sundance formation at depths of 4,185-4,190, 4,195-4,200, 4,205-4,210, and 4,245-4,250 at locality 7.

Remarks.—This species differs from *Cristellaria helios* Terquem in being biumbilicate rather than biumbonate, in having fewer chambers, in

being about one-half as large, and in having comparatively greater thickness.

Genus *Astacolus* Montfort, 1808

Astacolus ectypus Loeblich and Tappan, n. sp.

Pl. 1, figs. 14-18b

Lenticulina sculpta (Terquem and Berthelin), Sandidge, Amer. Midland Nat. **14**: 179, pl. 1, fig. 10. 1933.

Lenticulina sarthacensis (Schwager), Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. IV, **27**: 160, pl. 1, figs. 10a-b (not figs. 9 and 11). 1933.

Test free, large, auriculate to elongate in outline, early portion close-coiled, later uncoiling, with chambers extending back nearly or completely to the coil on the ventral margin, microspheric individuals showing a more enrolled early portion and broader test, while megalospheric forms are narrower and more evolute and elongate, periphery acute, keeled, ventral face truncate; chambers numerous, as many as 16 in well-developed microspheric specimens, as many as 11 in megalospheric specimens, sharply inflated just anterior to the sutures, well preserved specimens showing a distinct ridge which roughly parallels the sutures but sometimes is more strongly curved toward the aperture in the central portion of the test; sutures distinct, deeply depressed, curved; wall calcareous, hyaline, surface smooth, with no ornamentation other than the peripheral keel and the previously mentioned ridge paralleling the sutures; aperture at the peripheral angle, radiate.

Length of megalospheric holotype 0.70 mm, greatest breadth of coil 0.34 mm, greatest breadth above coil 0.31 mm, greatest thickness 0.21 mm. Length of microspheric paratype 0.78 mm, greatest breadth 0.42 mm, greatest thickness 0.21 mm. Other specimens vary in length from 0.36 to 0.86 mm.

Types and occurrence.—Holotype (U.S.N.M. no. 106035), figured paratypes (U.S.N.M. no. 106036a-c), and unfigured paratypes (U.S.N.M. no. 106037) from 47 to 52 feet above the base of the Stockade Beaver shale member of the Sundance formation at locality 4; unfigured paratypes (U.S.N.M. no. 106038) from 99 feet above the base, figured paratype (U.S.N.M. no. 106039) and unfigured paratypes (U.S.N.M. no. 106040) from 104 feet above the base, unfigured paratypes (U.S.N.M. no. 106041) from 134 feet above the base, all from the Rierdon formation at locality 5; unfigured paratypes (U.S.N.M. no. 106042) from 55 feet above the base and unfigured para-

types (U.S.N.M. no. 106043) from 81 feet above the base, both from the Rierdon formation at locality 1; unfigured paratypes (U.S.N.M. no. 106044) from the Sundance formation, in cuttings at 4,180-4,185 feet, at locality 7.

Remarks.—This species is similar to *Cristellaria sarthacensis* Schwager but differs in lacking the raised sutures and in being more evolute. In *A. ectypus*, n. sp., the sutures are depressed, but the chambers are inflated just anterior to the sutures, forming a distinct ridge. *Astacolus ectypus*, n. sp., differs from *Cristellaria sculpta* Terquem and Berthelin in being nearly twice as large and in having a much less well defined keel.

Wickenden (1933, p. 160) included under *Lenticulina sarthacensis* (Schwager) a specimen of this species, as well as specimens similar to those here described as *Lenticulina dilecta*, n. sp. *Astacolus ectypus*, n. sp., differs from *L. dilecta*, n. sp., in having a smaller coiled portion, with the later chambers uncoiling, in having strongly inflated chambers and depressed sutures rather than elevated and spinose sutures, and in lacking the open umbilicus.

Astacolus petalus Loeblich and Tappan, n. sp.

Pl. 1, figs. 19-21b

Test free, of medium size, auriculate in outline, much compressed, sides flat and parallel, early portion coiled, later uncoiling, later chambers extending back toward the proloculus on the ventral margin, periphery subtruncate; chambers numerous, as many as 10 or 11 in larger specimens, increasing very slightly in height as added, but increasing rapidly in breadth, so that later chambers are four to five times as broad as high; sutures gently curved, very slightly depressed, varying from quite distinct and clear in some specimens to somewhat obscure in others, so that they can be well distinguished only when the specimen is dampened; wall calcareous, hyaline, surface smooth; aperture at the peripheral angle, radiate.

Length of holotype 0.88 mm, greatest breadth 0.44 mm, greatest thickness 0.10 mm. Other specimens are from 0.39 mm to 0.91 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106045), figured paratypes (U.S.N.M. 106046a-b), and unfigured paratypes (U.S.N.M. no. 106047) from 47 to 52 feet above the base of the Stockade Beaver shale member of the Sundance formation at locality 4; unfigured paratypes (U.S.

N.M. no. 106048) from 55 feet above the base of the Rierdon formation and (U.S.N.M. no. 106049) from 81 feet above the base of the Rierdon formation, both from locality 1; unfigured paratypes (U.S.N.M. no. 106050) from 99 feet above the base of the Rierdon formation at locality 5.

Remarks.—*Astacolus petalus*, n. sp., is similar to *Cristellaria acuminata* Terquem but is nearly one-third smaller and has a less enrolled early portion. It differs from *Cristellaria anceps* Terquem in being nearly twice as large and in having less embracing chambers.

Genus *Marginulinopsis* Silvestri, 1904

Marginulinopsis phragmites Loeblich and Tappan,
n. sp.

Pl. 1, figs. 22–23b; text fig. 1.

Marginulina cf. *lacunata* (Terquem), Sandidge, Amer. Midland Nat. **14**: 180, pl. 1, figs. 6–8. 1933.

Marginulina cf. *lacunata* (Terquem and Berthelin), Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. iv, **27**: 162, pl. 1, fig. 13. 1933.

Marginulina cf. *sparsa* (Terquem and Berthelin), Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. iv, **27**: p. 161, pl. 1, fig. 14. 1933.

Test free, elongate, robust, early portion coiled, later portion rectilinear, rounded to slightly flattened in section; chambers numerous, increasing in size as added, as many as 10; sutures straight, radiate at first, later horizontal, obscured by the surface ornamentation; wall calcareous, hyaline, surface ornamented by 10 to 12 very strongly elevated costae, which are continuous across the sutures; aperture radiate, terminal, produced on a short neck.

Length of holotype 0.96 mm, greatest diameter of coil 0.26 mm, greatest breadth of uniserial portion 0.36 mm, greatest thickness 0.29 mm. Other specimens vary from 0.23 to 0.96 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106051), figured paratype (U.S.N.M. no. 106052), and unfigured paratypes (U.S.N.M. no. 106053) from the Stockade Beaver shale member of the Sundance formation, 47 to 52 feet above the base at locality 4; unfigured paratypes (U.S.N.M. no. 106054) from 33 feet above the base, figured paratype (U.S.N.M. no. 106055) and unfigured paratypes (U.S.N.M. no. 106056) from 55 feet above the base, unfigured paratypes (U.S.N.M. no. 106057) from 81 feet above the base, all from the Rierdon formation at locality 1; unfigured paratypes from 99 feet (U.S.N.M. 106058), 104 feet (U.S.N.M. no. 106059), and

134 feet (U.S.N.M. no. 106060) above the base of the Rierdon formation at locality 5; unfigured paratypes from 4,185–4,190 feet, (U.S.N.M. no. 106061), 4,195–4,200 feet (U.S.N.M. no. 106062), 4,200–4,205 feet (U.S.N.M. no. 106063), 4,205–4,210 feet (U.S.N.M. no. 106064), and 4,245–4,250 feet (U.S.N.M. no. 106065), all from cuttings in the Sundance formation at locality 7.



FIG. 1.—*Marginulinopsis phragmites* Loeblich and Tappan, n. sp.: Paratype (U.S.N.M. no. 106055), section showing globular proloculus and cristellarian coil, followed by uniserial chambers. $\times 72$.

Remarks.—*Marginulinopsis phragmites*, n. sp., is similar to *Cristellaria* (*Marginulina*) *jonesi* Reuss but is about one-half as large and has fewer ribs, which in most specimens traverse all the chambers. In *Cristellaria* (*Marginulina*) *jonesi* Reuss the ribs do not traverse the final chamber. *Marginulinopsis phragmites*, n. sp., differs from *Cristellaria lacunata* Terquem and Berthelin in possessing more ribs and in being much smaller. It differs from *Cristellaria sparsa* Terquem and Berthelin in possessing fewer ribs and in being of much larger size.

Genus *Vaginulinopsis* Silvestri, 1904

Vaginulinopsis eritheles Loeblich and Tappan,
n. sp.

Pl. 1, figs. 9a–13

Marginulina sp.? Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. iv, **27**: p. 163, pl. 1, figs. 12a–b. 1933.

Test free, large, elongate, early portion close-coiled and cristellarian in character, strongly inflated centrally, with an umbonal boss, periphery with a distinct keel, later portion uncoiling with periphery broadly rounded, microspheric forms broader and larger, with a better-developed coil than in the megalospheric specimens; chambers numerous, low and broad, as many as 12 in the final whorl of the microspheric form and 7 to 9 in the megalospheric form, followed by 2 to 4

uncoiled chambers which are inflated near the ventral margin and flattened toward the dorsal margin, so that the uniserial chambers are ovate to subtriangular in section; sutures slightly curved and flush with the surface in the cristellar portion, distinct to obscure, depending on the preservation of the specimen in question, depressed, nearly straight and quite distinct in the uncoiled portion; wall calcareous, hyaline, surface smooth; aperture radiate, at the peripheral angle which is somewhat produced.

Length of megalospheric holotype 0.96 mm, greatest breadth of coil 0.47 mm, greatest breadth of uniserial portion 0.29 mm, greatest thickness 0.23 mm. Length of microspheric paratype 1.40 mm, greatest breadth of coiled portion 0.62 mm, greatest breadth of uniserial portion 0.49 mm, greatest thickness 0.36 mm. Other specimens are from 0.44 mm to 1.40 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106066), figured paratypes (U.S.N.M. nos. 106067a-d), and unfigured paratypes (U.S.N.M. no. 106068) from the Stockade Beaver shale member of the Sundance formation, 47 to 52 feet above the base, at locality 4; unfigured paratypes (U.S.N.M. no. 106069) from 99 feet above the base and unfigured paratypes (U.S.N.M. no. 106070) from 104 feet above the base of the Rierdon formation, both from locality 5; unfigured paratypes (U.S.N.M. no. 106071) from 33 feet above the base, and unfigured paratypes (U.S.N.M. no. 106072) from 81 feet above the base, both from the Rierdon formation at locality 1; unfigured paratype (U.S.N.M. no. 106073) from the Sundance formation, in cuttings at 4,205-4,210 feet at locality 7.

Remarks.—This species resembles *Cristellaria centralis* Terquem from the Upper Bajocian of France in size and general appearance but is less compressed and has more horizontal and less depressed sutures. *Vaginulinopsis eritheles*, n. sp. differs from *Cristellaria vetusta* d'Orbigny in lacking the limbate sutures in the early part, in possessing depressed sutures in the later part, and in being of slightly larger size.

Genus *Dentalina* d'Orbigny, 1826

Dentalina gracilistriata Loeblich and Tappan, n. sp.

Pl. 1, figs. 24a-b

Test free, elongate, arcuate, of medium size; chambers uniserially arranged, slightly inflated centrally, increasing gradually in diameter as added, and more rapidly in length so that the

final chambers are of somewhat greater length than breadth; suture distinct, straight, slightly constricted; wall calcareous, hyaline, surface ornamented with numerous very fine wavering ribs, about 18 to 20 in number; aperture terminal, rounded, with margins showing indentations suggestive of a radiate character.

Length of holotype 0.81 mm, greatest breadth 0.16 mm.

Type and occurrence.—Holotype (U.S.N.M. no. 106074) from 47 to 52 feet above the base of the Stockade Beaver shale member of the Sundance formation at locality 4.

Remarks.—This species is somewhat similar to *Dentalina cylindrica* Schwager but differs in having lower chambers and in being ornamented by fine ribs. It differs from *D. fraasi* Schwager in having a less acuminate base and in possessing the fine ribs.

Dentalina ochyra Loeblich and Tappan, n. sp.
Pl. 1, figs. 25a-b

Test free, elongate, robust, slightly arcuate; chambers uniserially arranged, as many as 8 in well-developed specimens, increasing gradually in size as added from the rounded base, final chamber occasionally of somewhat less diameter than the preceding chamber; sutures straight, at right angles to the axis, occasionally slightly constricted, generally obscure; wall calcareous, hyaline, surface ornamented with about 16 to 18 low and narrow but continuous ribs of considerable regularity, increasing in number by intercalation as the test diameter increases; aperture terminal, radiate, on a short neck.

Length of holotype 1.07 mm, maximum diameter 0.26 mm. Other specimens varying in length from 0.44 mm to 1.09 mm.

Types and occurrence.—Holotype (U.S.N.M. no. 106075) and unfigured paratypes (U.S.N.M. no. 106076) from the Stockade Beaver shale member of the Sundance formation, 47 to 52 feet above the base, at locality 4; unfigured paratypes (U.S.N.M. no. 106077) from 139 feet above the base and unfigured paratypes (U.S.N.M. no. 106078) from 81 feet above the base, both from the Rierdon formation at locality 1; unfigured paratypes (U.S.N.M. no. 106079) from the Rierdon formation, 15 feet above the base, at locality 2; unfigured paratypes (U.S.N.M. no. 106080) from the Rierdon formation, 134 feet above the base, at locality 5.

Remarks.—This species somewhat resembles *Dentalina pectinata* Terquem, from the Upper

Bajocian of France, in general appearance and in having numerous ribs, but it is about twice as large and the test is almost cylindrical instead of constricted at the sutures. It is similar to *Dentalina confluens* Reuss but has less oblique sutures and is approximately one half as large.

Dentalina polyholca Loeblich and Tappan, n. sp.
Pl. 1, figs. 26-28

Test free, elongate, rectilinear, tapered or sub-cylindrical; chambers numerous, as many as 10, increasing gradually in size from the rounded proloculus in the microspheric specimens, but increasing very little in height or diameter in the megalospheric forms, final chamber sometimes of reduced size; sutures fairly distinct, straight, slightly constricted; wall calcareous, hyaline, surface ornamented with numerous fine ribs, about 20 to 25 in number, which are slightly undulating and occasionally bifurcate; aperture terminal, radiate, on a slight neck.

Length of microspheric holotype 1.20 mm, greatest diameter 0.21 mm; length of megalospheric paratype 0.70 mm, greatest diameter 0.18 mm. Other specimens are from 0.49 mm to 1.20 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106081) and unfigured paratypes (U.S.N.M. no. 106082) from the Rierdon formation, 15 feet above the base, at locality 2; figured paratypes (U.S.N.M. no. 106083) and unfigured paratypes (U.S.N.M. no. 106084) from the Stockade Beaver shale member of the Sundance formation, 47 to 52 feet above the base, at locality 4; unfigured paratype (U.S.N.M. no. 106085) from the Rierdon formation, 134 feet above the base, at locality 5; unfigured paratype (U.S.N.M. no. 106086) from the Rierdon formation, 81 feet above the base, at locality 1.

Remarks.—This species is similar to *D. angusticosta* Cushman, but has a more robust test and is about one-half as large. It is somewhat similar to *Nodosaria amphioxys* Reuss but has many more ribs, less constricted chambers, and an eccentric aperture.

Genus *Nodosaria* Lamarek, 1812

Nodosaria orthostoecha Loeblich and Tappan,
n. sp.

Pl. 1, figs. 33a-b

Nodosaria cf. *corallina* Gümbel, Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. iv, 27: 165, pl. 2, fig. 11. 1933.

Test free, elongate, rectilinear, of medium size; chambers numerous, as many as 7, varying from subglobular to somewhat broader than high, increasing very little in diameter as added, in many specimens the proloculus is of greater diameter than any of the succeeding chambers; sutures distinct, straight, constricted; wall calcareous, hyaline, surface ornamented with about 12 to 13 straight, narrow, longitudinal costae; aperture radiate, terminal, on a short neck.

Length of holotype 0.94 mm, greatest breadth 0.21 mm. Other specimens vary from 0.23 mm to 0.94 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106087) and unfigured paratypes (U.S.N.M. no. 106088) from the Rierdon formation, 55 feet above the base, at locality 1; unfigured paratypes (U.S.N.M. no. 106089) from the Rierdon formation, 134 feet above the base, at locality 5; unfigured paratypes (U.S.N.M. no. 106090) from the Rierdon formation, 15 feet above the base, at locality 2.

Remarks.—This species is similar to *Nodosaria fontinensis* Terquem, but is about one-third smaller, has slightly lower chambers, and considerably more numerous ribs. It differs from *Nodosaria hortensis* Terquem in being nearly one-third larger and in having many more ribs.

Nodosaria sphingothalama Loeblich and Tappan,
n. sp.
Pl. 1, figs. 34a-b

Test free, large, stout, elongate, rectilinear; chambers subglobular, increasing gradually in size, numerous, as many as five may be present, although specimens are usually fragmental due to the delicate nature of the test; sutures distinct, straight, strongly constricted, so that the tests are frequently broken at the sutures; wall calcareous, hyaline, surface ornamented with about 22 strong, coarse, straight, longitudinal costae, which are somewhat less prominent at the sutures; aperture terminal, radiate, on a distinct neck.

Length of holotype 0.99 mm, greatest breadth 0.34 mm. Other specimens are from 0.73 mm to 1.27 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106091) and unfigured paratypes (U.S.N.M. no. 106092) from the Rierdon formation, 55 feet above the base, at locality 1; unfigured paratypes (U.S.N.M. no. 106093) from the Rierdon formation, 15 feet above the base, at locality 2.

Remarks.—This species is similar to specimens

figured by Terquem under the name *Nodosaria fontinensis*, but differs in being nearly twice as large and in having fewer but more prominent costae.

Genus *Lingulina* d'Orbigny, 1826

Lingulina charagmata Loeblich and Tappan, n. sp.
Pl. 1, figs. 31a-b

Test free, flattened, of medium size, rhomboidal in outline, periphery subacute; chambers numerous, low and equitant, very highly arched, as many as 10 in large specimens; sutures distinct, forming an acute angle toward the aperture, somewhat elevated and thickened; wall calcareous, hyaline, with fairly large perforations, giving a pitted appearance; aperture terminal, elongate.

Length of holotype 0.52 mm, greatest breadth 0.34 mm, thickness 0.08 mm. Other specimens are from 0.29 mm to 0.73 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106094) and unfigured paratypes (U.S.N.M. no. 106095) from the Rierdon formation, 15 feet above the base, at locality 2; unfigured paratypes (U.S.N.M. no. 106096) from the Stockade Beaver shale member of the Sundance formation, 47 to 52 feet above the base, at locality 4.

Remarks.—This species is similar to *Fron dicularia oolithica* Terquem, but is twice as large, has less acutely angled sutures, and a less compressed test.

Lingulina hathra Loeblich and Tappan, n. sp.
Pl. 1, figs. 29a-30

Fron dicularia cf. *franconica* Gümbel, Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. iv, 27: p. 164, pl. 2, fig. 5. 1933.

Fron dicularia lingulaeformis Schwager, Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. iv, 27: p. 164, pl. 2, figs. 4 and 10. 1933.

Test free, large, elongate, flattened, periphery rounded, extremely variable in outline, some specimens elongate with parallel sides, as in the holotype, others palmate with tapered base, and still others comparatively narrow and elongate and almost cylindrical, large suites of specimens showing all gradations between these extremes; equitant chambers increasing gradually in size from the rounded proloculum, low and broad, as many as 10; sutures distinct, slightly depressed or flush with the surface, occasionally slightly constricted; wall calcareous, hyaline, surface ornamented with numerous very fine striae which

tend to converge toward the middle of the broad test, at the apertural ends of the chambers; aperture terminal, radiate, on a slight neck.

Length of holotype 1.35 mm, greatest breadth 0.29 mm, greatest thickness 0.18 mm. Other specimens are from 0.36 to 1.35 mm in length.

Types and occurrence.—Holotype (U.S.N.M. No. 106097), figured paratype (U.S.N.M. no. 106098), and unfigured paratypes (U.S.N.M. no. 106099) from the Stockade Beaver shale member of the Sundance formation, 47 to 52 feet above the base, at locality 4; unfigured paratypes (U.S.N.M. no. 106100) from the Rierdon formation, 55 feet above the base, at locality 1; unfigured paratypes from 4,180-4,185 feet (U.S.N.M. no. 106101), 4,195-4,200 feet (U.S.N.M. no. 106102), 4,215-4,220 feet (U.S.N.M. no. 106103), and 4,320-4,325 feet (U.S.N.M. no. 106104), all from cuttings in the Sundance formation at locality 7.

Remarks.—This species differs from *Fron dicularia laevisissima* Terquem in having lower chambers and in possessing the abundant fine striae. It may be distinguished from *Fron dicularia franconica* Gümbel by its slightly larger size, more broadly angled sutures, less flaring test, and less distinct apertural neck. It is differentiated from *Fron dicularia lingulaeformis* Schwager in being about six times as large, in having higher chambers, more acutely angled sutures, and a less acuminate base.

Lingulina rursa Loeblich and Tappan, n. sp.
Pl. 1, figs. 32a-b

Test elongate, narrow, tapering, much compressed, periphery sub-acute; chambers numerous, low and broad, equitant, 10 to 13 in large specimens, increasing fairly rapidly in breadth as added in the early part, later increasing more slowly; sutures very slightly depressed, strongly arched centrally, forming an acute angle, somewhat obscure unless specimens are dampened; wall calcareous, hyaline, surface smooth; aperture terminal, elongate.

Length of holotype 0.83 mm, greatest breadth 0.23 mm, greatest thickness 0.08 mm. Other specimens are from 0.26 mm to 0.83 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106105) and unfigured paratypes (U.S.N.M. no. 106106) from 139 feet above the base of the Rierdon formation, unfigured paratypes

(U.S.N.M. no. 106107) from 55 feet above the base of the Rierdon formation, all from locality 1; unfigured paratypes (U.S.N.M. no. 106108) from the Rierdon formation, 15 feet above the base, at locality 2; unfigured paratypes (U.S.N.M. no. 106109) from the Stockade Beaver shale member, 47 to 52 feet above the base, at locality 4; unfigured paratypes from 99 feet above the base (U.S.N.M. no. 106110), 104 feet above the base (U.S.N.M. no. 106111), and 134 feet above the base (U.S.N.M. no. 106112), all from the Rierdon formation at locality 5.

Remarks.—This species is similar to *Fronicularia oolithica* Terquem, but is approximately one-third larger and has less limbate sutures and the test is more compressed.

Genus *Tristix* Macfadyen, 1941

Tristix nitidula Loeblich and Tappan, n. sp.

Pl. 1, figs. 37a-b

Dentalinopsis oolithica ? (Terquem), Wickenden, Trans. Royal Soc. Canada, ser. 3, sec. IV, 27: p. 167, pl. 2, figs. 6a-b. 1933.

Test free, elongate, narrow, tapering slightly toward the base, triangular in section, angles rounded; chambers numerous, six in the holotype, increasing very little in height as added except that the final chamber is proportionately larger than earlier chambers; sutures flush with the surface, indistinct unless specimen is dampened, slightly arched in the center of the sides, curving downward at the angles; wall calcareous, hyaline, surface smooth; aperture terminal, rounded.

Length of holotype 0.73 mm, greatest breadth across side 0.23 mm.

Types and occurrence.—Holotype (U.S.N.M. no. 106113) from the Stockade Beaver shale member, 47 to 52 feet above the base, at locality 4.

Remarks.—*Tristix nitidula*, n. sp., differs from *Tritaxia oolithica* Terquem in having a more slender test and more rounded angles, as seen in cross section. It differs from *Tristix liasina* (Berthelin) in being considerably larger and in having more rounded angles.

Genus *Vaginulina* d'Orbigny, 1826

Vaginulina mecyna Loeblich and Tappan, n. sp.

Pl. 1, figs. 38a-b

Test free, elongate, narrow, compressed, triangular in side view; chambers numerous, as many as 12, low and broad, highest dorsally, in-

creasing gradually in breadth as added; sutures distinct, oblique, highest at the dorsal margin, thickened and slightly depressed; wall calcareous, hyaline, surface smooth; aperture terminal at the dorsal angle, on a slight neck-like extension of the final chamber, rounded, but with faint radiate markings.

Length of holotype 1.25 mm, greatest breadth 0.29 mm, greatest thickness 0.10 mm. Other specimens range from 0.65 to 1.38 mm in length.

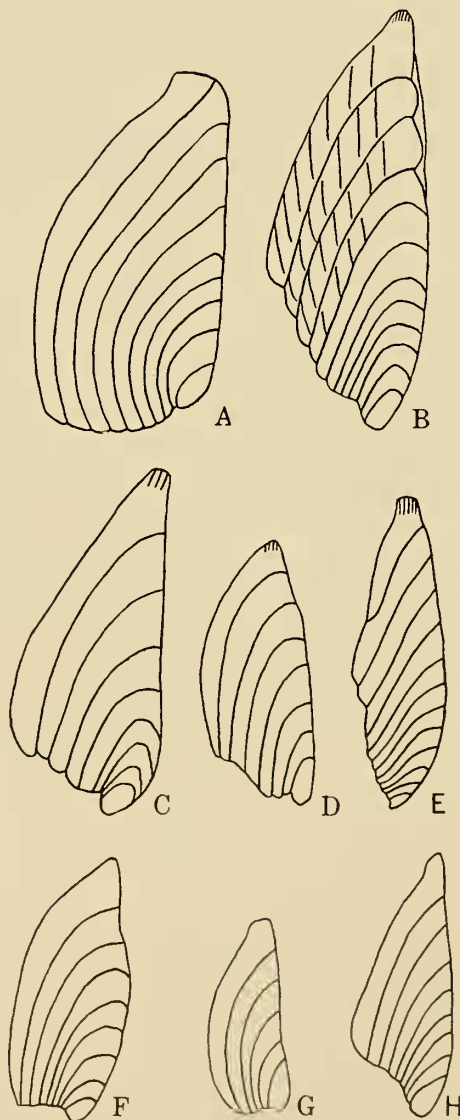


FIG. 2.—*Citharina latissima* Loeblich and Tappan, n. sp., paratypes: A (U.S.N.M. no. 103152), B to H (U.S.N.M. nos. 106155 a-g), showing variation in outline and ornamentation. $\times 41$.

Types and occurrence.—Holotype (U.S.N.M. no. 106148) and unfigured paratypes (U.S.N.M. no. 106149) from the Rierdon formation, 15 feet above the base, at locality 2.

Remarks.—*Vaginulina mecyna*, n. sp., is similar to *Marginulina solida* Terquem var. F of Terquem, but it is about a third larger and has a more tapering base, more numerous chambers, slenderer form, and a more produced final chamber.

Genus *Citharina* d'Orbigny, 1839

Citharina latissima Loeblich and Tappan, n. sp.
Pl. 1, figs. 40a-b; text figs. 2A-H

Test free, large, elongate, much compressed, triangular in side view but varied in outline, periphery truncate; chambers numerous, low and broad, increasing rapidly in breadth as added, increasing very little in height, highest dorsally; sutures distinct, thickened, slightly depressed, curving gently from near the proloculus at the ventral margin to a much higher position on the dorsal margin; wall calcareous, hyaline, surface smooth, except where ornamented by very low and narrow ribs that cross the chambers obliquely and are interrupted by the sutures, number of ribs present is variable, all gradations being observed from smooth tests to those completely covered with the ribs; aperture terminal, radiate, on a short neck at the dorsal angle.

Length of holotype 1.61 mm, greatest breadth 0.60 mm, greatest thickness 0.10 mm. Other specimens range from 0.26 to 2.00 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106150) and unfigured paratypes (U.S.N.M. no. 106151) from the Stockade Beaver shale member, 47 to 52 feet above the base, at locality 4; figured paratype (U.S.N.M. no. 106152) from 33 feet above the base, unfigured paratypes from 55 feet above the base (U.S.N.M. no. 106153), 81 feet above the base (U.S.N.M. no. 106154), figured paratypes (U.S.N.M. no. 106155) and unfigured paratypes (U.S.N.M. no. 106156) from 139 feet above the base, all from the Rierdon formation at locality 1; unfigured paratypes from 99 feet above the base (U.S.N.M. no. 106157), 104 feet above the base (U.S.N.M. no. 106158), and 134 feet above the base (U.S.N.M. no. 106159), all from the Rierdon formation at locality 5.

Remarks.—A few of the variations in outline are shown in the accompanying text figures. This species is similar to *Marginulina condita*

Terquem, but the American species differs in having fewer and less prominent costae, and in general the chambers are more overhanging.

Genus *Citharinella* Marie, 1938

Citharinella compara Loeblich and Tappan, n. sp.
Pl. 1, figs. 36a-b; text figs. 3A-D

Test free, elongate, palmate, increasing gradually in size, early portion citharine, later portion frondicularian, periphery subacute; chambers numerous, only three to four citharine chambers followed by as many as seven highly arched equitant chambers that form an acute angle distally; sutures distinct, slightly depressed, strongly oblique in the citharine portion, highly arched in the frondicularian portion; wall calcareous, hyaline, surface smooth, ornamented by numerous very fine low ribs; aperture terminal, radiate, on a slight neck.



FIG. 3.—*Citharinella compara* Loeblich and Tappan, n. sp., paratypes: A-D (U.S.N.M. nos. 106161a-d), showing variation in outline and ornamentation. $\times 36$.

Length of holotype 1.43 mm, greatest breadth 0.47 mm, greatest thickness 0.10 mm. Other specimens are from 0.39 to 1.43 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106160), figured paratypes (U.S.N.M. nos. 106161a-d), and unfigured paratypes (U.S.N.M. no. 106162) from the Stockade Beaver shale member, 47 to 52 feet above the base, at locality 4; unfigured paratypes from 99 feet above the

base (U.S.N.M. no. 106163) and 134 feet above the base (U.S.N.M. no. 106164), both from the Rierdon formation, at locality 5; unfigured paratypes from 55 feet above the base (U.S.N.M. no. 106165), 139 feet above the base (U.S.N.M. no. 106166), both from the Rierdon formation, at locality 1; unfigured paratypes (U.S.N.M. no. 106167) from the Rierdon formation, 15 feet above the base, at locality 2; unfigured paratype (U.S.N.M. no. 106168) from cuttings at 4,210–4,215 feet in the Sundance formation at locality 7.

Remarks.—*Citharinella compara*, n. sp., is distinguished from *Flabellina jurensis* Franke by its slightly larger size, less arcuate initial portion and its ornamentation of numerous fine ribs.

Citharinella latifolia Loeblich and Tappan, n. sp.

Pl. 1, figs. 35a–b; text figs. 4A–C

Test free, palmate, short and robust, compressed, periphery truncate; chambers numerous, citharine portion reduced, generally consisting of only two or three chambers, followed by as many as six equitant chambers that are much broader but of nearly the same height as the early chambers; sutures distinct, slightly depressed, arched centrally, forming almost a right angle toward the aperture; wall calcareous, hyaline, surface ornamented by numerous rather coarse costae of about the same width as the depressions between costae; aperture terminal, radiate, on a slight neck.

Length of holotype 0.99 mm, greatest breadth 0.47 mm, greatest thickness 0.10 mm. Other specimens are from 0.65 to 1.12 mm in length.

Types and occurrence.—Holotype (U.S.N.M. no. 106169), figured paratypes (U.S.N.M. no. 106170), and unfigured paratypes (U.S.N.M. no. 106171) from the Stockade Beaver shale member, 47 to 52 feet above the base, at locality 4; unfigured paratype (U.S.N.M. no. 106172) from the Rierdon formation, 15 feet above the base, at locality 2; unfigured paratypes (U.S.N.M. no. 106173) from 33 feet above the base and (U.S.N.M. no. 106174) from 55 feet above the base, both from the Rierdon formation, at locality 1.

Remarks.—This species differs from *Flabellina jurensis* Franke in having a much broader test and in being ornamented by rather coarse costae. It differs from *Flabellina karrerri* Berthelin in lacking the extremely acuminate early portion and by having chambers which are less strongly recurved.

Genus *Tribrachia* Schubert, 1912

Genotype (here designated).—*Tribrachia inelegans* Loeblich and Tappan, n. sp.

Schubert described the genus *Tribrachia* in 1912, for the tri-radiate frondicularian Foraminifera, but cited no species. As the species *Tribrachia inelegans* Loeblich and Tappan, here described, is the first species to be published in connection with the generic name *Tribrachia*, it thus becomes the genotype. Previously described species that rightfully belong to this genus are *Fronicularia amoena* Reuss and *Fronicularia tricarinata* d'Orbigny. These species were included by ten Dam and Schijfsma in the genus *Tricarinnella*, which is, however, a synonym of *Tristix* Macfadyen. *Tristix* and *Tribrachia* are quite distinct, the former having the appearance of a triradiate *Lingulina* whereas the latter is more similar to a triradiate *Fronicularia*.

Cushman (1948: 219) stated that "some of the Cretaceous species [of *Fronicularia*] have a supplementary angle and have been named *Tribrachia* by Schubert. The name may perhaps be used for these specialized species." Galloway (1933: 242) included *Tribrachia* in the synonymy of *Fronicularia* as "monstrosities with three edges." The writers believe Schubert's genus to be distinct from *Fronicularia*. In the Rierdon formation we have seen no species of true *Fronicularia*, and thus the species here described cannot be merely a monstrosity. We have also seen true *Tribrachia* in the American Cretaceous. Although in some horizons we have seen specimens with a third angle which were obviously monstrosities of *Citharinella*, *Palmula* and *Fronicularia*, these freakish specimens merely suggest a relationship between these lagenid genera. The occurrence of

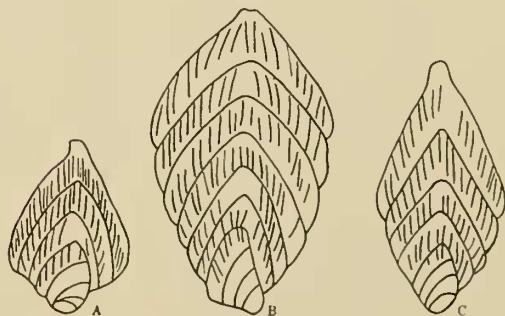


FIG. 4.—*Citharinella latifolia* Loeblich and Tappan, n. sp., paratypes: A–C (U.S.N.M. nos. 106170–a–c), showing variation in plan, outline, and ornamentation. $\times 36$.

Tribrachia not associated with any of these genera establishes the validity of the genus.

Tribrachia inelegans Loeblich and Tappan, n. sp.
Pl. 1, figs. 39a-b

Test free, elongate, tapering, triangular in section, angles truncate; about six chambers, each trifoliate in section, with sides of each radius nearly parallel, chambers increasing in breadth as added but only slightly in height; sutures distinct, depressed, very highly arched near the central portion of the test, curving far backward toward the proloculus at the angles; wall calcareous, hyaline, surface smooth; aperture terminal, radiate.

Length of holotype 0.91 mm, greatest breadth 0.34 mm. Length of paratype 1.17 mm, greatest breadth 0.36 mm.

Types and occurrence.—Holotype (U.S.N.M. no. 106175) and unfigured paratype (U.S.N.M. no. 106176) from the Rierdon formation, 134 feet above the base at locality 5.

Remarks.—*Tribrachia inelegans*, n. sp., differs from *Fronicularia tricarinata* d'Orbigny in having a somewhat smaller and comparatively broader test. It is differentiated from *Fronicularia amoena* Reuss by its broader test and more acutely angled sutures.

Family SPIRILLINIDAE

Genus *Turrispirillina* Cushman, 1927

Turrispirillina spirella Loeblich and Tappan, n. sp.
Pl. 1, figs. 41a-b

Cornuspira orbicula (Terquem and Berthelin), Sandidge, Amer. Midland Nat. 14: 178, pl. 1, fig. 14. 1933.

Test free, small, consisting of a proloculus and elongate, tubular, evolutely coiled second chamber that forms a low conical spire, concave ventrally; spiral suture distinct; wall calcareous, hyaline, surface smooth; aperture rounded, at the end of the tube.

Greatest diameter of holotype 0.29 mm, greatest thickness 0.05 mm. Other specimens are from 0.16 mm to 0.29 mm in diameter.

Types and occurrence.—Holotype (U.S.N.M. no. 106177) and unfigured paratypes (U.S.N.M. no. 106178) from the Rierdon formation, 15 feet above the base, at locality 2.

Remarks.—This species is probably the same as that recorded by Sandidge, but our specimens

are not as large. It differs from *Spirillina orbicula* Terquem and Berthelin in being conically spiral rather than planispirally coiled; otherwise the two are very similar.

REFERENCES

- CUSHMAN, J. A. *Foraminifera, their classification and economic use*. 1948.
DAM, A. TEN, and SCHIJFSMA, E. *Sur un genre nouveau de la famille Lagenidae*. C. R. Somm. Seances Soc. Géol. France, no. 16. 1945.
GALLOWAY, J. J. *A manual of Foraminifera*. 1933.
IMLAY, R. W. *Characteristic marine Jurassic fossils from the western interior of the United States*. U. S. Geol. Surv. Prof. Paper 214-B. 1948.
SANDIDGE, J. R. *Foraminifera from the Jurassic in Montana*. Amer. Midland Nat. 14. 1933.
WICKENDEN, R. T. D. *Jurassic Foraminifera from wells in Alberta and Saskatchewan*. Trans. Royal Soc. Canada, ser. 3, sec. IV, 27. 1933.

EXPLANATION OF PLATE 1

- 1, 2.—*Anmodiscus cheradospirus* Loeblich and Tappan, n. sp.: 1, Side view of holotype (U.S.N.M. no. 106014), showing regular, evolutely planispiral coil; 2a, side view of paratype (U.S.N.M. no. 106015); 2b, edge view. $\times 36$.
- 3, 4.—*Frankeina commutata* Loeblich and Tappan, n. sp.: 3a, Side view of holotype (U.S.N.M. no. 106017), showing large and prominent coil followed by triangular uniserial portion of less diameter; 3b, top view, showing rounded aperture; 4, side view of young paratype (U.S.N.M. no. 106021), showing coiled portion and initial portion of uniserial stage. $\times 20$.
- 5-8.—*Lenticulina dilecta* Loeblich and Tappan, n. sp.: 5a, Side view of paratype (U.S.N.M. no. 106027a), showing trochoid character occasionally seen in this species; 5b, opposite side of trochoid paratype; 6, side view of paratype (U.S.N.M. no. 106027b), showing elevated sutures; 7a, side view of holotype (U.S.N.M. no. 106026), showing elevated sutures and depressed umbilicus with encircling ridge formed by coalescing ends of the sutures; 7b, edge view, showing peripheral keel and flattened apertural face; 8, side view of paratype (U.S.N.M. no. 106027c) showing elevated sutures with minute projecting lateral spines. $\times 36$.
- 9-13.—*Vaginulinopsis erithales* Loeblich and Tappan, n. sp.: 9a, Side view of holotype (U.S.N.M. no. 106066), showing typical megalospheric characters; 9b, edge view, showing peripheral keel; 10, side view of paratype (U.S.N.M. no. 106067a), showing rare development of *Nodosaria*-like uniserial chambers; 11, microspheric

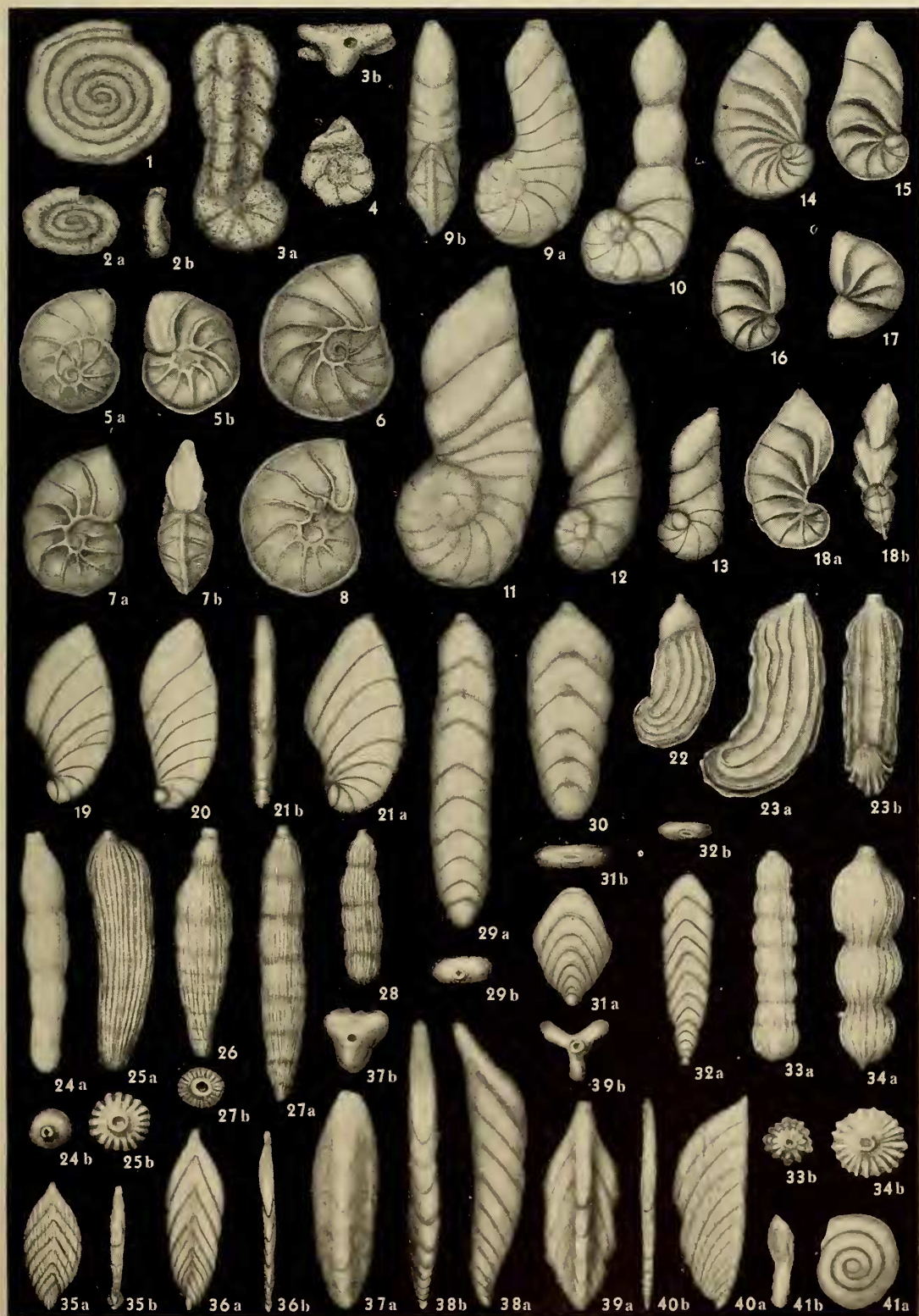


PLATE 1.—(For explanation see pages 16, 18, 19).

- paratype (U.S.N.M. no. 106067b), showing large coil, and distinctly depressed sutures in the uniserial portion; 12, side view of paratype (U.S.N.M. no. 106067c), showing a more irregular development of the uniserial chambers; 13, side view of paratype (U.S.N.M. no. 106067d), a small megalospheric individual. $\times 36$.
- 14-18.—*Astacolus ectypus* Loeblich and Tappan, n. sp.: 14, Side view of paratype (U.S.N.M. no. 106036a), showing auriculate outline; 15, side view of paratype (U.S.N.M. no. 106036b), showing elongate test; 16, side view of paratype (U.S.N.M. no. 106036c), showing large amount of overlap in final chamber; 17, side view of "twinned" paratype (U.S.N.M. no. 106039); 18a, side view of holotype (U.S.N.M. no. 106035), showing depressed sutures bordered anteriorly by a sharp ridge formed by the inflation of the chamber; 18b, edge view, showing peripheral keel, deeply depressed sutures and truncate apertural face. $\times 36$.
- 19-21.—*Astacolus petalus* Loeblich and Tappan, n. sp.: 19, Side view of paratype (U.S.N.M. no. 106046a) showing broad and low chambers; 20, side view of paratype (U.S.N.M. no. 106046b), showing narrower form; 21a, side view of holotype (U.S.N.M. no. 106045), showing auriculate outline and smooth character of the test; 21b, edge view, showing even thickness throughout length. $\times 36$.
- 22, 23.—*Marginulinopsis phragmites* Loeblich and Tappan, n. sp.: 22, Side view of paratype (U.S.N.M. no. 106052), showing unornamented final chamber; 23a, side view of holotype (U.S.N.M. no. 106051), showing indistinct sutures and prominent costae traversing the length of the test; 23b, edge view. $\times 36$.
- 24.—*Dentalina gracilistriata* Loeblich and Tappan, n. sp.: 24a, Side view of holotype (U.S.N.M. no. 106074), showing slightly arcuate test, nearly horizontal sutures, and fine striae; 24b, top view. $\times 48$.
- 25.—*Dentalina ochyra* Loeblich and Tappan, n. sp.: 25a, Side view of holotype (U.S.N.M. no. 106075), showing indistinct sutures and coarse ribs; 25b, top view. $\times 36$.
- 26-28.—*Dentalina polyholca* Loeblich and Tappan, n. sp.: 26, Side view of paratype (U.S.N.M. no. 106083a), showing tapering of test at both ends; 27a, side view of holotype (U.S.N.M. no. 106081), showing nearly horizontal sutures and abundant striae; 27b, top view; 28, side view of small paratype (U.S.N.M. no. 106083b), showing less acuminate base. $\times 36$.
- 29, 30.—*Lingulina hathra* Loeblich and Tappan, n. sp.: 29a, Side view of holotype (U.S.N.M. no. 106097), showing comparatively narrow and elongate microspheric form; 29b, top view, showing terminal and faintly radiate aperture; 30, side view of paratype (U.S.N.M. no. 106098), showing broader and shorter megalospheric form. $\times 36$.
- 31.—*Lingulina charagmata* Loeblich and Tappan, n. sp.: 31a, Side view of holotype (U.S.N.M. no. 106094), showing rhomboidal outline and limbate highly arched sutures; 31b, top view, showing compressed form and elongate aperture. $\times 36$.
- 32.—*Lingulina rursu* Loeblich and Tappan, n. sp.: 32a, Side view of holotype (U.S.N.M. no. 106105), showing narrow elongate form and sharply angled sutures; 32b, top view, showing subacute margins and elongate aperture. $\times 36$.
- 33.—*Nodosaria orthostoecha* Loeblich and Tappan, n. sp.: 33a, Side view of holotype (U.S.N.M. no. 106087), showing narrow elongate test and subglobular chambers of approximately equal diameter; 33b, top view, showing numerous ribs and terminal aperture. $\times 36$.
- 34.—*Nodosaria sphingothalama* Loeblich and Tappan, n. sp.: 34a, Side view of holotype (U.S.N.M. no. 106091), showing large inflated chambers, constricted sutures, and continuous ribs; 34b, top view, showing numerous ribs and radiate aperture. $\times 36$.
- 35.—*Citharinella latifolia* Loeblich and Tappan, n. sp.: 35a, Side view of holotype (U.S.N.M. no. 106169), showing abbreviated early *Citharina*-like portion and coarse striae covering the test; 35b, edge view, showing bulbous early portion. $\times 20$.
- 36.—*Citharinella compara* Loeblich and Tappan, n. sp.: 36a, Side view of holotype (U.S.N.M. no. 106160), showing small citharine stage followed by acutely angled frondicularian chambers with surface ornamentation consisting of fine striations; 36b, edge view, showing uniform thickness of the test. $\times 20$.
- 37.—*Tristix nitidula* Loeblich and Tappan, n. sp.: 37a, Side view of holotype (U.S.N.M. no. 106113), showing moderately excavated sides and rounded angles; 37b, top view, showing terminal rounded aperture and rounded angles. $\times 48$.
- 38.—*Vaginulina mecyna* Loeblich and Tappan, n. sp.: 38a, Side view of holotype (U.S.N.M. no. 106148), showing triangular form, oblique sutures, and necklike extension of the final chamber; 38b, edge view. $\times 36$.
- 39.—*Tribrachia inclegans* Loeblich and Tappan, n. sp.: 39a, Side view of holotype (U.S.N.M. no. 106175), showing deeply excavated sides and acutely angled sutures; 39b, top view, showing aperture and deeply excavated sides. $\times 36$.

40.—*Citharina latissima* Loeblich and Tappan, n. sp.: 40a, Side view of holotype (U.S. N.M. no. 106150), showing low and broad chambers, thickened sutures, and low narrow ribs; 40b, edge view, showing compressed form. $\times 20$.

41.—*Turrispirillina spirella* Loeblich and Tappan, n. sp.: 41a, Dorsal view of holotype (U.S.N.M. no. 106177), showing globular proloculus and long, undivided second chamber; 41b, edge view, showing very low spire. $\times 48$.

BOTANY.—*Ectosperma*, a new genus of grasses from California.¹ JASON R. SWALLEN, U. S. National Museum.

A very unusual and striking grass was collected by Miss Annie M. Alexander and Miss Louise Kellogg in the course of exploration in Inyo County, California, early last summer. It was submitted to the author for identification by Dr. H. L. Mason, of the University of California. It was evident at once that the grass did not belong to any species known from the United States, and on further examination it proved to be not only a new species but a new genus. One of the characters is the free caryopsis which falls from the floret very early and easily, sometimes even before it is entirely mature. The generic name selected refers to this character.

Ectosperma Swallen gen. nov.

Spiculae paniculatae 3–7-florae, rachilla continua; glumae subaequales, spicula paulo breviores, 7–11-nerves; lemmata 5–7-nervia, exaristata, marginibus in parte inferiore dense villosa; palea lemma aequans, tenuis, ovata, truncata, nervis minute excurrentibus, marginibus latis dense villosa; caryopsis decidua; stylorum bases persistentes; hilum circulare, depressum; embryo latus ellipticus, caryopsi $\frac{1}{3}$ brevior; styli elongati, stigmatibus plumosis.

Spikelets 3–7-flowered, the rachilla continuous, the florets persistent, crowded, successively smaller; glumes subequal, nearly as long as the florets, spreading, 7–11-nerved, some of the nerves faint; lemmas 5–7-nerved, awnless, densely villous on the margins in the lower half, sometimes also on the internerves; palea as long as or a little longer than the lemma, thin, broad, ovate, the broad margins densely villous with long hairs nearly to the summit, sparsely villous on the back at the base, the apex erose-truncate, the nerves excurrent in short awns; caryopsis readily

falling from the floret, elliptic, roughly rectangular in cross section, the style bases persistent as short points; hilum circular, depressed; embryo broad, elliptic, nearly two-thirds the length of the grain; styles elongate with the stigmas plumose on all sides; stamens 3.

Stiff perennial, apparently with long underground stems or rhizomes, relatively short, flat, stiff blades, and narrow, simple panicles of large, pale hairy spikelets.

Ectosperma alexandrae Swallen, sp. nov.

Culmi erecti, rhizomatosi (?), ramis fertilibus et sterilibus praediti; rami steriles internodiis brevibus nodis lanato-villosis et foliis densis instructi; rami fertiles graciliores, internodiis superioribus elongatis; vaginae dense ciliatae in ore et collo villosae vel eae remorum fertilium subglabrae; ligula 1 mm. longa, dense ciliata; laminae 4–14 cm longae, 3–6 mm latae, acuminatae, nervosae, glabrae, vel supra scaberulae; paniculae 4–10 cm longae, ramis brevibus, appressis, 1–3-spiculatis; spiculae 1–1.5 cm longae; glumae 9–14 mm longae, acuminatae, glabrae; lemma primum 8–9 mm longum, acutum vel mucronatum; caryopsis 4 mm longa, 2 mm lata, fusca; antherae 3.5 mm longae.

Culms erect with sterile and fertile branches; sterile branches stout with short internodes, lanate-villous nodes, and crowded leaves, the fertile ones more slender, at least the upper internodes elongate; sheaths rounded, densely ciliate, villous at the throat and on the collar, or those of the flowering branches nearly glabrous; ligule 1 mm long, densely ciliate; blades 4–14 cm long, 3–6 mm wide, acuminate, strongly nerved, glabrous, or scaberulous on the upper surface; panicles 4–10 cm long, the branches short, appressed, bearing 1–3 spikelets; spikelets 1–1.5 cm long, nearly as wide; glumes 9–14 mm long, acuminate, glabrous; first lemma 8 mm long, acute or mucronate; caryopsis 4 mm long, 2 mm wide, brown; anthers 3.5 mm long.

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